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UTAH HIGHWAY SAFETY DIVISION

1975 to 1978

ANALYSIS OF MOTORCYCLE SAFETY IN UTAH

MOTORCYCLE ACCIDENT INVESTIGATION
1975, 1976, 1977, 1978

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UTAH DEPARTMENT OF PUBLIC SAFETY

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A FOUR YEAR ANALYSIS OF MOTORCYCLE SAFETY IN UTAH

UTAH DEPARTMENT OF PUBLIC SAFETY

UTAH HIGHWAY SAFETY DIVISION

November, 1979

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ABSTRACT

The purpose of this analysis is to examine motorcycle safety in Utah during 1975 through 1978. All circumstances which influenced motorcycle safety will be measured and described. Such circumstances include motorcycle crashes, injuries, fatalities, motorcycle usage and public opinion. Profiles of the numerous variables which are characteristic of motorcycles and highway traffic safety will be presented. The above will be done to identify present problems and thereby assess future needs.

I. INTRODUCTION AND BACKGROUND

In striving to achieve compliance with the Highway Safety Standards which evolved from the Highway Safety Act of 1966, the State of Utah gained a leading position in programs dealing with highway-traffic safety. One such standard deals with motorcycle safety and calls for each State to require motorcycle operators and passengers to wear approved helmets. Subsequent to the enactment of the Highway Safety Program Standards, a motorcycle bill was introduced to the 1969 session of the Utah Legislature. Senate Bill No. 76 entitled, "Special Rules for Motorcycles and Motor-Driven Cycles", set the standards for helmet usage, but only on roadways with a posted speed in excess of 35 mph. This clause set Utah apart from other states in headgear legislation, and resulted in the implementation of a comprehensive Motorcycle Safety Program.

The 1977 session of the Utah Legislature passed Senate Bill No. 31, which relaxed helmet requirements to apply only to persons under 18 years of age on all roadways. In addition, the bill removed all requirements related to the use of eye protection while operating a motorcycle. Such legislative changes have caused a re-emphasis of countermeasures in motorcycle safety, together with continued efforts in problem identification techniques as they relate to the effects of the relaxation of requirements for protective devices.

A. Motorcycle Safety Program and Countermeasure Description

Utah has chosen to approach the motorcycle safety problem from a different perspective. Different in the sense that it implies an educational and preventative approach to motorcycle safety.

In recognition of the many problems associated with motorcycle safety, Utah initiated a seven-phase countermeasure program in order to find an effective and practical method of dealing with motorcycle crashes. The

program was made up of countermeasures in Driver Education, Driver Licensing, Enforcement, Public Information, Legislation, Judicial, and Problem Identification.

The initial analysis of motorcycle safety in Utah rendered valuable insights into the value and practicality of the various aspects of the program. As a result of such findings, a total of four countermeasures were retained as integral countermeasure areas. The remaining modalities were either discontinued or merged into other general program areas (i.e., driver licensing and driver education).

The objectives of the total program are: To obtain more information concerning injuries and fatalities incurred as a result of motorcycle crashes, to evaluate the problems so as to determine needs and gaps in motorcycle safety, and to reduce the frequency of motorcycle crashes in Utah. The following countermeasures have been developed to accomplish the aforementioned goals.

1. Enforcement

   In order to increase the awareness of law enforcement personnel and upgrade the level of enforcement in the areas of motorcycle equipment, licensing, helmet usage, and speed violations, an enforcement countermeasure has been made a part of the Motorcycle Safety Program. The Utah Highway Safety Office proposes to use its influence to increase law enforcement emphasis concerning motorcycle safety problems in the above areas. To assure cooperation, continual contacts will be made with the Utah Highway Patrol and the larger enforcement agencies throughout the State.

2. Public Information

   The purpose of the Public Information countermeasure is to reduce motorcycle crashes caused by the lack of public awareness on the part of the motorcycle drivers and the general driving public. Both motorcycle safety informational brochures and radio and television spot announcements have been used.

3. Legislation

   The main intent of the Legislative countermeasure is to secure the passage of legislation requiring all new applicants for motorcycle operator endorsements to have passed an approved motorcycle driver

education course. Such legislation will be presented to the 1981 Utah State Legislature.

4. Problem Identification

In order to obtain more information on motorcycle injuries and fatalities, the Problem Identification countermeasure proposes to determine the factors related to injuries and fatalities in motorcycle crashes. Activities include the implementation and upkeep of a motorcycle safety management information system which will determine the relationship of such variables as helmet usage, age, experience, and speed. Other tools, such as surveys to measure the level of public awareness of motorcycle safety will be incorporated, together with medical information concerning injuries resulting from fatal crashes.

B. Motorcycle Safety Profile

Over the years Utah has remained consistent with other states in terms of increases in motorcycle usage. Motorcycle riding, both as a mode of transportation and recreational activity, has enjoyed a tremendous increase in popularity during the last decade. In Utah, motorcycle usage as measured by registration has greatly increased over the last ten years. In 1969, there were 20,700 motorcycles registered in the State, By 1974, the number increased to 51,962. Registrations decreased somewhat in 1976 to 50,214 and in 1978 they reached 52,360. In ten years the number of registered motorcycles in Utah has increased 153%. Passenger car registration, on the other hand, has imcreased 36% over a period of ten years. In 1969, motorcycles represented approximately 4% of the total registered cars and motorcycles in the State. In 1978, the proportion of motorcycles increased to 8%. Between 1969 and 1978, the number or registered motorcycles in Utah had more than doubled.

Motorcycle and Passenger Car Registration

Year	Motorcycle	Passenger Car
1969	20,700	464,180
1970	28,194	477,143
1971	37,064	508,137
1972	45,703	536,080
1973	51,702	570,566
1974	51,962	577,624
1975	50,934	574,983
1976	50,214	602,952
1977	53,025	610,144
1978	52,360	633,964

When comparing motorcycle and passenger car fatality rates for the same period of time, it can be noted that motorcycle fatals reached a high in 1973, while passenger car fatals reached their highest point in 1970.

When considering fatalities for both groups as a percentage of registration, it can be demonstrated that the average fatality rate per number of registrations over the ten year period is almost identical for motorcycles and passenger cars. Since 1974, the percentage of motorcycle fatalities per registered motorcycle has remained below the nine year average.

	Fatalities			
Year	Motorcycle	% Of Registration	Other Vehicles	% of Registration
1969	9	.043	238	.051
1970	12	.042	301	.063
1971	16	.043	272	.053
1972	28	.061	278	.051
1973	32	.062	269	.047
1974	22	.042	170	.029
1975	21	.041	199	.034
1976	17	.034	177	.029
1977	24	.045	259	.042
1978	23	.044	306	.048
Average	20.4	.046	247	.045

An extension of this discussion, to include motorcycle and passenger car injury figures, renders some interesting results. In 1969, there were approximately 454 motorcycle injury accidents. By 1978, motorcycle injury crashes increased to 1005. Automobiles, on the other hand, showed a total of 9,850 injury accidents in 1969 and 13,423 in 1978. Although the number of motorcycle injury accidents have increased by 121%, the number of registered motorcycles increased by 153% since 1969. Furthermore, while 1978 motorcycle registrations account for approximately 8% of the State's registered vehicles, 1978 motorcycle injury accidents accounted for only 7% of injury accidents. With this data in mind, motorcycle injury accidents are not over-represented as a proportion of registered vehicles.

Injury crashes and Registration

	Registration		Injury Crashes			
Year	Motorcycle	Passenger Car	Motorcycle	% Per Regis.	Passenger Car	% Per Regis.
1969	20,700	459,074	454	2.1	9,850	2.1
1970	28,194	446,127	698	2.4	10,722	2.4
1971	37,064	514,074	879	2.3	11,399	2.2
1972	45,703	536,080	952	2.1	11,630	2.2
1973	51,702	570,566	853	1.6	11,710	2.1
1974	51,962	577,624	991	1.9	10,560	1.8
1975	50,934	574,983	885	1.6	11,441	2.0
1976	50,214	602,952	926	1.8	11,685	1.9
1977	53,025	610,144	840	1.0	12,652	2.1
1978	52,360	633,964	1005	1.9	13,423	2.1
Average	44,185	552,658	845	1.9	11,507	2.1

II. RESEARCH DESIGN

The following section concerns the procedures which were used in drawing the "samples" upon which this analysis is based. This section also deals with the data included in the samples; methods of collecting and selection; and presents an analysis of the degree to which the data may be relied upon for making conclusions concerning the total area under investigation.

A. Data Collection

In order to adequately describe motorcycle safety in Utah, the State Highway Safety Division has collected, coded and stored a variety of data. During 1975 to 1978, a comprehensive record of the motorcycle safety environment was maintained through sampling a wide variety of related portions of the population which directly or indirectly influence this highway safety area. The following are representations of the data collection tools and techniques:

1. Motorcycle Safety Management Information System

The M.I.S. file contains data which spans over a six year period 1973-1978. Numerous entries have been stored in the file including motor vehicle fatalities, pedestrian accidents, and 3,690 of the 1975 to 1978 motorcycle crashes. A total of 292 of the 1975 motorcycle accidents, 254 of the 1976 accidents, 329 of the 1977, and 405 of the 1978 accidents on file are complete with respect to containing all required crash information.

2. Supplemental Motorcycle Accident Report Form

The State of Utah requires that an Accident Report Form be filled out at the scene of every motor vehicle accident by the investigating officer. In order to enrich the material contained in this form, the Highway Safety Office developed a supplemental form to be completed at the scene of all motorcycle accidents. These forms contain needed information regarding driver, vehicle, injury, and equipment data not found in the regular form. Copies of these supplements were completed by the officer and forwarded to the Highway Safety Office for data element decoding and storage in the Management Information File.

3. Driver History

Another source of data to be incorporated into this analysis is driver history data. A complete driving record was collected on individuals involved in motorcycle crashes in Utah during 1975, 1976, 1977 and 1978. Such data was obtained from the Utah Driver License Division and stored in the Management Information System as an indicator of personal driving behavior.

4. Public Opinion Survey

Public opinion surveys were developed and administered at selected driver license examining stations throughout the Wasatch Front. The purpose of the opinion surveys was to measure the level of the driving public's support and knowledge of various factors related to motorcycle safety. Each year a stratified random sample of 1,100 drivers was used, with stratification according to four counties in the Wasatch Front area. Further categorization was made by dividing the sample to include 50% motorcyclists and 50% general driving public.

5. Roadside Surveys

In order to specifically measure the level of helmet usage by motorcyclists at all speed limits, three surveys of actual observation of motorcyclists were completed at randomly selected locations throughout the Wasatch Front. Two surveys were conducted during that period of time when Utah's helmet law required headgear usage at speeds above 35 mph, and one survey during 1978; one year after the law was amended to apply only to cyclists under 18 years of age regardless of speed.

B. Validity of Crash Data

Of the 3,691 crashes used to analyze injury severity in this study, 1,280 were complete with respect to the supplemental information requested. It was necessary to determine if these 1,280 were representative of all 3,691 crashes before proceeding with the final injury severity analyses. For example, if the 1,280 complete crashes were predominantly urban crashes and the 2,411 incomplete crashes were predominantly rural, then the analysis of the 1,280 complete crashes must apply only to urban crashes.

To make this comparison, a discriminant analysis of the two groups of crashes (supplement versus no supplement) was performed. The dependent variable in the analysis was whether or not the helmet was worn or whether this information was unknown. The reason for choosing this variable was that it was the most impor-

tant variable requested on the supplemental report form. Without this information, it would not have been possible to determine the interrelationships among head injury severity, speed, helmet use, etc.

The resulting discriminant analysis showed that the helmet use categories were different in sixteen variables at the 5% level of significance. Ten of these variables were binary variables indicating unknown data. The other three variables were indicators of off-road accidents (parking lots, driveways, etc.), the state of driver license, and the validity of inspection.

It was determined that these variables were interrelated, in that if an accident is reported for insurance purposes only, much of the other data is missing. For example, only 36 of 2,483 crashes without the supplemental information had the inspection information. In addition, those data elements which are routinely collected for all crashes such as driver license, vehicle and speed information were almost proportionately identical for the two groups.

It is reasonable to conclude from this analysis that the 1,280 crashes with supplemental reports are representative of crashes occurring on public streets and roads.

C. Data Analysis Techniques

The crash data was keypunched and stored in a format suitable for use with existing statistical analysis software. The software used to summarize and analyze the data was the Statistical Package for the Social Sciences (SPSS).

The crash data was summarized using frequency counts and two-way tables for the purposes of editing and describing the data. The statistical technique used for inferential purposes was discriminant analysis. The dependent variable was some area of injury severity (head, extremities, overall, etc.). When the results of the analysis showed two adjacent classes to be statistically the same these classes were grouped together. Since many of the variables were qualitative

in nature, heavy use was made of binary variables. The prior probabilities were the sample size proportions in each category of injury severity. The level of significance for entry or deletion of variables in the stepwise analysis was 10%.

The helmet usage surveys were summarized manually. The driver opinion surveys were keypunched and analyzed for interrlationships using the SPSS Crosstabs program.

III. DATA ANALYSIS

A. Crash Incidence Contributing Factors

In this section of the study those factors which are most directly associated with the causes of motorcycle crashes will be analyzed. Each category or factor to be described contains several variables which will be analyzed and correlated according to their importance in the accident sample. This analysis is based on a comparative frequency distribution of 292 accident cases from 1975, 254 accident cases in 1976, 329 cases in 1977, and 405 in 1978.

1. Speed

Speed as a pre-crash incidence contributing factor contains three classifications which have been collected in each year's accident sample. These were travel speed, impact speed, and speed limit. In this analysis the speed variable shall be analyzed in terms of accidents occurring at speeds above or below 35 mph.

A profile of the 1975 accident sample demonstrated that 46% of the accidents occurred at travel speeds below 35 mph, while the remaining 54% occurred at higher speeds. In 1976, 55% of the accidents occurred at travel speeds below 35 mph, in 1977, 53% of the accidents occurred within this range, and in 1978, 57% of the accidents occurred at the lower speeds. In carrying the analysis further to include impact speed, 1975 data demonstrated that 75% of the accidents occurred at impact speeds below 35 mph. In 1976, 78% of the accidents occurred at impact speeds under 35 mph, and 1977, 77% occurred under 35 mph, and in 1978, 82% occurred under 35 mph. Finally, when speed limit data was categorized, it was found that 28% of the 1975 accidents, 42% of the 1976 accidents, 28% of the 1977 accidents and 37% of the

1978 accidents occurred on roads with speed limits below 35 mph. The above illustration demonstrated no significant difference between the years in terms of the travel and impact speeds at which accidents occurred. Speed limit data indicates that the number of accidents occurring under the 35 mph limit increased substantially in 1976 over 1975, but in 1977, the frequency of accidents occurring at lower speed limits decreased downward to the 1975 level, and then averaged out again in 1978.

DISTRIBUTION OF CRASHES

BY

TRAVEL SPEED, IMPACT SPEED, AND SPEED LIMIT

Speed mph	Travel				Impact				Limit			
	1975	1976	1977	1978	1975	1976	1977	1978	1975	1976	1977	1978
0 - 9	7.7	9.3	6.5	10.7	16.6	20.7	13.6	14.6	-	-	-	-
10 - 19	10.0	9.0	10.1	8.8	23.2	26.6	25.8	26.2	4.1	4.9	4.1	3.9
20 - 24	5.8	7.7	8.0	8.8	15.2	14.4	15.8	17.1	.5	1.4	.6	1.3
25 - 29	11.5	13.4	11.4	12.5	9.0	9.5	10.9	12.6	14.2	14.9	12.3	11.2
30 - 34	11.0	15.4	17.0	16.6	10.9	8.4	12.3	11.8	9.1	20.3	11.4	22.1
35 - 39	13.9	12.2	14.7	14.3	7.1	5.3	5.7	5.3	18.3	15.5	20.3	13.6
40 - 44	13.4	11.8	10.9	11.7	6.6	5.6	6.5	5.6	19.3	12.7	24.4	19.4
45 - 49	7.2	5.4	6.0	5.9	5.2	2.4	2.8	2.3	1.0	2.3	3.2	6.4
50 - 54	8.1	7.4	5.7	5.2	3.8	4.5	3.6	2.7	9.1	7.7	4.7	7.1
55 - +	11.4	8.4	9.7	5.5	2.4	2.6	3.9	1.8	24.4	20.3	19.0	15.0

2. Experience and Skill

In describing experience and skill as pre-crash incidence contributing factors in motorcycle accidents, a number of independent variables were used in the analysis. The factors which were extracted from the motorcycle accident sample to serve as indicators of experience and skill were motorcycle driving experience, driver training, and motorcycle endorsements.

It was shown from the anaylsis of the 1975 accident sample that 67% of the cyclists involved in crashes had less than 5 years of motorcycle driving experience, and 64% of the total cases had less than three years of driving experience on motorcycles. It was particularly significant that 52% of the total sample had less than two years motorcycle driving experience. The 1976 sample demonstrated that 76% of the cyclists involved in crashes had less than 5 years of motorcycle driving experience, and 60% of those individuals had less than three years of motorcycle driving experience. And finally, 51% of the 1976 sample had less than two years of motorcycle driving experience.

In 1977, 75% of the drivers involved in accidents had less than five years of motorcycle driving experience, 56% had less than three years, and 45% had less than two years of driving experience. In 1978, 67% of the drivers involved in motorcycle accidents had less than five years of motorcycle driving experience, 47% had less than three years, and 35% had less than 2 years of motorcycle driving experience.

Although there is little difference between the number of cyclists who have relatively little motorcycle driving experience in each year, it is evident that the number of inexperience cyclists has declined steadly since 1975. This decline in the frequency of drivers with little motorcycle experience is countered by yearly increases in terms of accident involvement by drivers having ten or more years of motorcycle driving experience.

A similar pattern exists when looking at general driving experience. In 1975, 45% of the drivers involved in motorcycle crashes had less than five years of general driving experience, compared to 52% in 1976, 56% in 1977, and 50% in 1978. There were similar increases related to individuals having less than three years and less than two years of general driving experience in 1976, 1977 and 1978 compared to 1975.

Driving experience was also gauged in terms of experience on the motorcycle involved in the crash (experience on this bike). Data for both 1975 and 1976 crashes were very similar in this category. In each year it was found that a very high proportion of drivers had one year or less experience on the motorcycle which they were driving at the time of the accident - 74% in 1975, 71% in 1976,

74% in 1977, and 76% in 1978, nearly the entire sample had less than five years of experience on the motorcycle which was involved in the crash - 99% in 1975, 98% in 1976, 16% in 1977 and 96% in 1978.

In conclusion, this analysis has demonstrated the large number of motorcycle drivers with little driving experience, whether it be motorcycle, general driving, or the motorcycle involved in the crash. Individuals with ten years or more of motorcycle driving experience and general driving experience are more heavily represented in 1978 motorcycle crashes than was the case in 1975. Irrespective of the above, the rates of inexperience in motorcycle crashes remains at high levels, retaining a significant relationship of inexperience and accident occurrence.

DRIVING EXPERIENCE IN MOTORCYCLE CRASHES

Years	Motorcycle %				General Driving %				This Motorcycle %			
	1975	1976	1977	1978	1975	1976	1977	1978	1975	1975	1977	1978
1	33.4	35.7	33.3	34.6	19.3	23.9	21.2	21.2	74.3	70.7	74.1	76.3
2	16.3	15.5	11.6	12.6	8.9	5.2	6.6	10.5	14.4	14.9	12.6	10.4
3	11.3	8.9	11.2	12.2	8.0	9.0	8.3	9.1	5.4	7.4	5.0	5.5
4	6.9	7.5	9.1	7.4	9.2	6.9	9.0	8.8	3.5	3.9	4.0	4.1
5	10.2	8.0	10.5	8.0	8.0	7.7	10.8	4.6	1.4	1.3	1.8	2.3
6	2.9	4.4	5.1	4.7	4.5	6.1	9.0	6.8	N/A	.9	1.1	.9
7	2.9	5.7	2.2	3.3	4.2	7.7	4.5	4.3	N/A	.9	-	.1
8	4.0	2.2	8.6	2.0	4.5	3.2	2.8	4.6	N/A	-	.4	.3
9	1.2	.9	.7	1.2	3.8	2.5	3.8	2.9	N/A	-	-	.1
10 +	10.9	11.2	12.7	14.0	28.7	27.8	24.0	27.7	1.0	-	1.0	-
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100

Two variables were used in the analysis as indicators of the motorcyclist's skill level. These indicators were driver training and motorcycle endorsements. In looking at driver training it was found that in 1975, 67% of all drivers involved in motorcycle crashes had received no driver training in any form. This figure increased to 70% in 1976 and decreased in 1977 to 63%, went to 66% in 1978. Additionally, when looking at motorcycle endorsements, it was shown that approximately 30% of the 1975 motorcycle drivers who were involved in crashes had not taken the State's Licensing Skill Test. The number of cyclists not having motorcycle endorsements remained at 31% during 1976, 34.2% in 1977 and 31% in 1978. The number of unskilled motorcycle drivers, as measured by driver education and motorcyle endorsements at the time of the crash remained about the same over the four year period. In all there is a large number of untrained and illegally licensed motorcycle drivers in the accident profile.

SKILL LEVELS IN MOTORCYCLE CRASHES

	Driver Education				Motorcycle Endorsement			
	1975	1976	1977	1978	1975	1976	1977	1978
Yes	32.7	29.6	37.1	34.4	69.6	68.6	66.2	69.4
No	67.3	70.4	62.9	65.6	30.4	31.4	33.8	30.6

3. Age

The respective ages of drivers involved in Utah motorcycle crashes are as follows:

Age	% of Total			
	1975	1976	1977	1978
Under 16	6%	13%	5%	3%
16 - 20	28%	30%	39%	33%
21 - 30	40%	42%	39%	35%
31 - 50	18%	13%	14%	18%
50 - +	8%	2%	3%	11%

During 1975 through 1978, the highest age group represented within the accident sample was in the 21-30 range. Since 1977, sample showed a decrease of involvement within this age group, and a substantial increase in the 16-20 age group. In 1975, 74% of all accidents occurred with the motorcycle operator under 30 years of age. In 1976, the number of accidents involving individuals within this age group rose to 85%, and decreased to 83% in 1977 and 71% in 1978.

4. Location and Environment

In attempting to determine the actual location of accidents and the environment in which they are most likely to occur, class of trafficway and adverse surface conditions were used as indicators. It was discovered that of all the accident cases sampled the vast majority occurred in urban locations and very few occurred on Interstate and limited access roads.

ACCIDENT LOCATION

	Urban	Rural	Interstate	U. S. and State Roads	Local Streets
1975	81%	19%	6%	42%	52%
1976	95%	5%	4%	40%	56%
1977	97%	3%	4%	33%	63%
1978	89%	11%	3%	38%	59%

With respect to the environment in which accidents occurred, adverse surface conditions were used as a descriptive variable. Out of the entire sample, 95% of the cases had no adverse conditions listed.

ADVERSE SURFACE CONDITIONS

	None	Rain	Dry and Slippery	Mud or Snow	Fog Or Smog
1975	96%	4%	-	-	-
1976	94%	-	3%	3%	-
1977	96%	4%	-	-	-
1978	94%	4%	-	-	2%

Looking specifically at cities and counties in which motorcycle accidents occurred, it was discovered that in each year the greatest proportion of city accidents occurred in Salt Lake City - 25%, 20%, 21% and 20% respectively. Ogden City followed with a total of 8% of the accidents in 1975, 7% in 1976, and 6% in 1977 and 1978. Provo was the third largest represented city with 7% of the motorcycle crashes in 1975, 5% in 1976, 5% in 1977 and 4% in 1978. The above three cities together accounted for approximately 40% of all 1975 motorcycle acci-

dents, 32% of all 1976 and 1977 crashes and 30% of all 1978 crashes. The incidence of accidents in larger cities had decreased since 1975. Accident frequencies in intermediate and second class cities remained fairly consistent over the three-year study period.

When motorcycle crashes in counties were considered, it was found that the most highly represented counties were Salt Lake, Utah, Weber, Davis and Tooele. While the above counties are the most highly represented in each year's accident picture, the relative number of crashes have decreased in these areas since 1975.

MOTORCYCLE CRASHES IN CITIES

City	% of Total Accidents			
	1975	1976	1977	1978
Salt Lake City	25%	20%	21%	20%
Ogden	8%	7%	6%	6%
Provo	7%	5%	5%	4%
South Salt Lake	2%	2%	2%	2%
Granger	2%	2%	2%	2%
Orem	3%	4%	2%	3%
Murray	2%	2%	3%	3%
Midvale	2%	2%	1%	1%
Logan	1%	1%	2%	2%
Other and Unincorporated	48%	65%	66%	57%

MOTORCYCLE CRASHES IN COUNTIES

	% of Total Accidents			
	1975	1976	1977	1978
Salt Lake	52%	48%	47%	49%
Utah	17%	14%	11%	11%
Weber	14%	12%	10%	12%
Davis	5%	7%	10%	8%
Tooele	3%	2%	2%	2%
Other	9%	17%	20%	18%

5. Driver

This section of the analysis attempts to characterize the drivers which

were involved in 1975, 1976 1977 and 1978 motorcycle accidents. In demonstrating the characteristics of drivers, a variety of variables have been used. These include protective equipment, registration and license, and driver history.

With respect to protective equipment, two variables were examined in the analysis. These variables were helmet worn and eye protection. It was found that in 1975, 61% of the drivers were utilizing head protection through the use of a safety helmet. Eye protection was worn by approximately 59% of the drivers involved in 1975 motorcycle accidents. The 1976 to 1978 samples demonstrated decreases in the number of motorcyclists utilizing protective equipment. The later samples showed that 32% of the drivers used head protection in 1978 as opposed to 61% in 1975. A reduction was shown with respect to those wearing eye protection, 36% in 1978, compared to 59% in 1975. The 1977 and 1978 accident sample has shown a dramatic decline regarding the use of head and eye protection. Such decreases are probably directly attributable to the changes in Utah's Motorcycle Legislation.

	Yes				No			
	1975	1976	1977	1978 --	1975	1976	1977	1978
Head Protection	61%	59%	32%	32%	39%	41%	68%	68%
Eye Protection	59%	51%	34%	36%	41%	49%	66%	64%

Registration and license were used in this analysis as a partial indicator of the number of in and out-of-state drivers. In 1975, it was found that 86% of the drivers involved in accidents were registered Utah drivers and the remaining 14% were either non-registered or out-of-state drivers. Of the 1976 accidents, 91% were shown to be registered Utah motorcyclists and the remaining 9% non-registered or out-of-state.

The 1977 and 1978 samples demonstrated little change from 1976 figures. In terms of licensed drivers, and 1975 analysis demonstrated that 80% of the cases were licensed Utah drivers and the remaining 20% might represent out-of-state, non-licensed recreational, or non-licensed drivers. This compares to a very similar distribution in 1976 and 1978. In 1977, 90% of the drivers had a valid operator license. This proportion of valid licensed drivers in motorcycle accidents since 1975, was 80%, 82%, 90% and 80% respectively.

	Utah Registration				Valid Operator License			
	1975	1976	1977	1978	1975	1976	1977	1978
Yes	86%	91%	90%	90%	80%	82%	90%	80%
No	14%	9%	10%	10%	20%	18%	18%	20%

Driver history data serves as an indicator of the driving patterns and/or habits of individuals involved in motorcycle accidents. Looking at previous accidents, it was found that in 1975, 24% of the drivers had been involved in at least one prior mishap. Subsequent samples showed even smaller proportions of drivers who had been involved in a previous accident, 19% in 1976, 10% in 1977 and 12% in 1978. It was also discovered that a higher percentage of drivers in the 1976 and 1977 analysis, had their license suspended at least one time prior to the accident, 21% in 1976 and 18% in 1977, as compared to 10% in 1976 and 6% in 1978.

PREVIOUS ACCIDENTS

	Yes	No
1975	24%	76%
1976	19%	81%
1977	10%	90%
1978	12%	88%

PREVIOUS SUSPENSIONS

	None	1	2	3	4	5	6
1975	90%	5%	3%	1%	5%	0	5%
1976	79%	9%	6%	3%	1%	1%	1%
1977	82%	7%	5%	3%	1%	1%	1%
1978	94%	4%	2%	-	-	-	-

Other driving offenses which the drivers might have committed prior to their involvement in the accident are as follows:

Offenses	Previous DUI				Previous Speeding				Previous Other			
	1975	1976	1977	1978	1975	1976	1977	1978	1975	1976	1977	1978
None	96%	93%	93%	96%	54%	42%	47%	49%	60%	56%	55%	64%
1	3%	5%	5%	3%	25%	27%	25%	26%	30%	26%	28%	24%
2	1%	1%	1%	1%	11%	14%	12%	14%	7%	12%	9%	7%
3	-	1%	1%	-	4%	11%	9%	7%	1%	5%	4%	3%
4	-	-	-	-	5%	5%	5%	3%	2%	-	2%	1%
5	-	-	-	-	1%	1%	-	1%	2%	-	2%	1%

It seems quite apparent from the foregone driver history data that a high proportion of the drivers involved in 1975, 1976, 1977 and 1978 motorcycle accidents were involved in previous accidents or had a number of previous driving offenses. While the number of individuals having previous offenses had increased slightly over the years, there were only half as many drivers with previous crashes on record in 1978 (12%) compared to 1975 (24%).

6. Vehicle

In attempting to determine the vehicle profile of the accident samples, the vehicle model variable was chosen. Vehicle model in this analysis has been sub-categorized by size of bike in terms of cubic centimeters. Over the years, accident frequencies regarding motorcycle size have demonstrated an increase in terms of the involvement of larger bikes in motorcycle crashes. Vehicle models and their respective involvement in accidents is as follows:

Cubic Centimeters	% Of Accident Involvement			
	1975	1976	1977	1978
0 - 99	10%	10%	4%	4%
100 - 249	21%	15%	16%	16%
250 - 399	28%	30%	31%	25%
400 - 799	32%	33%	34%	40%
800 - +	9%	12%	15%	15%

7. Time and Season

Of the accident cases which were analyzed in 1975, approximately 100% of them occurred from May to September. During 1976, 81% of all accidents occurred from May to September, 69% occurred during this period in 1977 and 72% of the 1978 accidents occurred during these 5 months. The 1976 to 1978 years sample has demonstrated a trend away from seasonal clusters of accident occurrence. A breakdown of accidents and the months in which they occurred is listed on the following page.

Motorcycle Accidents By Month

	1975	1976	1977	1978
January	-	1%	1%	1%
February	-	1%	4%	3%
March	-	4%	4%	6%
April	-	10%	11%	9%
May	3%	17%	10%	11%
June	22%	15%	19%	15%
July	39%	16%	17%	17%
August	26%	13%	13%	18%
September	10%	10%	10%	11%
October	-	8%	6%	6%
November	-	3%	4%	2%
December	-	2%	1%	1%

Looking at day and time of day, the highest frequency of 1975 accidents (58%), occurred between 2:00 p.m. and 10: p.m. The highest concentration of accidents at a particular time period was 28%, which fell between 4:00 p.m. and 7:00 p.m. The majority of 1976 accidents (66%), occurred between the hours of 6:00 a.m. and 4:00 p.m. Two time periods accounted for the largest cluster of accidents - 23% between 6:00 a.m. and 12:00 noon, and 23% between 12:00 noon and 4:00 p.m.

In 1977, the highest single cluster of accidents occurred between 4:00 p.m. and 7:00 p.m. (24%). As was the case in previous years, 1978 accidents occurred most frequently and were somewhat evenly dispersed in daylight time periods - 6:00 a.m. to 10:00 p.m. The single worst time period over the four year average was the evening rush between 4:00 p.m. and 7:00 p.m.

Time			% of Accidents			
			1975	1976	1977	1978
1:00 AM	-	6:00 AM	9%	5%	6%	6%
6:00 AM		12:00 NOON	24%	23%	10%	17%
12:00 NOON	-	2:00 PM	7%	20%	11%	10%
2:00 PM	-	4:00 PM	15%	23%	17%	13%
4:00 PM	-	7:00 PM	28%	14%	24%	28%
7:00 PM	-	10:00 PM	15%	10%	19%	19%
10:00 PM	-	12:00 AM	2%	5%	7%	7%

8. Collision

In this analysis two variables were used as descriptors of motorcycle collisions - first harmful event and manner of collision. The variable labeled first harmful event is meant to imply the event which characterizes the object that the motorcycle collided with at the time of the accident. This variable has been recorded and categorically analyzed in terms of non-collision, collision with a motor vehicle, and collision with a fixed object.

Looking at non-collision, it was found that of the 1975 accident cases, 35% of the accidents occurred in this manner. This figure most closely represents accidents which occurred due to loss of control or some other event not associated with a physical collision. Of the accidents sampled, 60% occurred due to collision with some type of vehicle. The remaining 5% of the accidents occurred as a result of a collision with a fixed object (bridge part, street sign, fire hydrant, etc.). The 1976 to 1978 samples showed a decrease in the number of non-collision motorcycle crashes, and increases in collisions with other vehicles and collision with fixed object accidents.

First Harmful Event

	Non-Collision	Collision W/Other Vehicle	Collision W/Fixed Object
1975	35%	60%	5%
1976	27%	63%	10%
1977	24%	68%	8%
1978	26%	62%	12%

In this analysis manner of collision was sub-categorized into four categories. These categories were rear-end, head-on, angle, and sideswipe. It is interesting to note the high proportion of angle type motorcycle accidents. The 1977 and 1978 data shows this type of accident as having increased more than any other category. Such data tends to support related studies which point to angle collisions as the most prominent type of motorcycle crash.

Manner of Collision

	1975	1976	1977	1978
Rear-end	18%	24%	18%	18%
Head-on	8%	4%	3%	2%
Angle	70%	70%	75%	78%
Sideswipe	4%	2%	4%	2%

9. Contributing Circumstances

The contributing circumstances variable is meant to imply the occurrence which most directly contributed to the accident. Two levels of prime contributing circumstances were used to more accurately describe the causes of accidents. These sub-categories were termed driver level and accident level contributing factors. The former of the two classifications denotes driver error, while the latter implies environmental contributing factors.

Of the 1975 cases, approximately 43% of the accidents demonstrated no driver error of any kind. The most pronounced driver errors in accidents were drinking, reckless driving, failure to yield, and speeding. Such errors accounted for approximately 44% of all the accidents in 1975.

From 1975 to 1978, speeding and reckless driving maintained a position of being the most common contributing factors to Utah's motorcycle accidents.

Driver Level Contributing Factors

	1975	1976	1977	1978
Drinking	5.8%	3.0%	2.9%	2.3%
Following Improperly	3.7%	3.8%	5.4%	2.6%
Improper Passing	3.7%	3.0%	2.6%	2.8%
Reckless Driving	14.5%	16.8%	14.5%	16.4%
Failure to Yield	4.4%	4.7%	4.4%	5.1%
Speeding	19.6%	18.9%	24.3%	18.2%
Improper Turns	1.5%	1.3%	1.6%	1.1%
Driving-Wrong Side (Road)	3.7%	.9%	2.6%	1.8%
All Other	-	2.2%	.5%	1.2%
None	43.1%	45.4%	41.2%	48.5%

From the analysis of the data regarding accident level contributing factors, it was discovered that in all years such factors played a relatively small role in motorcycle crashes. During the last four years, 82% of all the accident cases demonstrated no accident level contributing factors in the crash. During each year, the most significant of such contributing factors were avoiding cars, obstructed visions and slippery surfaces. Other related accident level factors played a much smaller role in crashes. The most significant contributing circumstances in motorcycle crashes, therefore, are those which are associated with the driver as opposed to the environment.

Accident Level Contributing Factors

	1975	1976	1977	1978
Obstructed Vision	1.5%	1.6%	3.0%	4.1%
Slippery Surface	4.0%	6.0%	4.0%	4.0%
Bad Road Surface	.5%	.5%	-	.3%
Avoiding Animal	.5%	.8%	.8%	.5%
Avoiding Car	2.8%	6.9%	4.0%	6.1%
Maintenance	3.2%	2.9%	.4%	.3%
Construction	1.4%	1.2%	1.0%	1.3%
None	86.1%	76.4%	83.9%	83.4%

B. Injury Profile

The major question to be analyzed in this section of the study is injury severity in motorcycle crashes. Through the use of discriminant analysis, it has been possible to calculate and prioritize a variety of variables which contribute most significantly, or are in some way related to various forms of injury severity. Injuries which occur on different parts of the body will be individually analyzed. Bodily injuries associated with motorcycle crashes include head, torso, and extremities (arms, legs).

The intensities of physical impairment have been collected and coded according to the National Highway Traffic Safety Administration's Injury Code. These categories include fatal injury, bleeding wound, bruises and abrasions, momentary pain and no injury. For purposes of simplification, injury categories in this study have been classed as severe, moderate, and no injury.

Of all categories of bodily injury, head injury severity is of foremost concern. The use and value of protective headgear has, over the years, been the primary issue surrounding motorcycle safety. Because of the high probability of injury resulting from motorcycle crashes, various states have set

requirements which deal with the wearing of helmets. The quantitative measurements related to helmet use and injury severity should alleviate many questions which now surround this issue.

1. Body Injuries

Considering all injuries in the accident sample which the motorcycle drivers sustained on different parts of the body, it was found that head injury severity is the least represented form of injury. Through grouping each year (1975, 1976, 1977 and 1978) it was found that 71% of the sample sustained no head injury as a result of the crash. The number of individuals sustaining no torso, arm, and leg injuries is substantially lower. The most highly represented form of injuries in motorcycle crashes are leg injuries.

The analysis demonstrated that 30% of the drivers sustained no leg injuries, while 70% suffered either moderate or severe leg injuries.

Bodily Injury Severity

	None	Moderate	Severe
Head	71%	12%	17%
Torso	57%	33%	10%
Arm	35%	44%	21%
Leg	30%	46%	24%

When injury categories were summarized by respective year, it was discovered that there was a decrease in individuals sustaining no head injuries from 1975 to 1978. Conversely, the number of individuals sustaining moderate or severe head injuries increased over the four year study period. It is significant to note the increase in severe head injuries during 1978 and 1977 over 1976 and 1975. The most significant decrease in individuals sustaining no head injuries occurred in 1977, together with a corresponding increase in individuals sustaining moderate or severe head injuries.

Head Injury Severity

	None	Moderate	Severe
1975	74%	11%	15%
1976	72%	13%	15%
1977	63%	18%	19%
1978	68%	12%	20%

Such a trend is not apparent when considering other forms of bodily injury. The numbers of individuals sustaining no torso, arm, and leg injuries do not decrease over the years, but rather, remain somewhat stable.

Torso Injury Severity

	None	Moderate	Severe
1975	56%	33%	11%
1976	55%	36%	9%
1977	55%	35%	10%
1978	56%	37%	9%

Arm Injury Severity

	None	Moderate	Severe
1975	35%	42%	23%
1976	34%	43%	23%
1977	35%	43%	22%
1978	34%	46%	20%

Leg Injury Severity

	None	Moderate	Severe
1975	27%	46%	27%
1976	31%	47%	22%
1977	33%	43%	24%
1978	28%	49%	23%

2. Discriminant Analysis

In order to pinpoint the extent of the relationship of different variables, a discriminant classification of independent variables which contribute to bodily injury was carried out. The analysis was based upon a sample of 292 motorcycle crashes which occurred in 1975, 254 accident cases from 1976, 329 cases from 1977 and 405 from 1978. All samples were combined which facilitated an analysis of 1280 accident cases. Each variable selected as being significant to some form of bodily injury was cross-tabulated to determine its role according to the degree of injury. In addition,

all categories of physical impairment (head, torso, etc.) were analyzed so as to determine the significance of their respective roles in motorcycle crashes.

Because the use of helmets and their relationship to head injury severity is of foremost concern, a presentation of the head injury discriminant anaylsis only will be carried out, as opposed to all forms of bodily injuries. A discriminant analysis was used to extract all related crash variables which were most closely associated with the head injury category. Such variables were selected in a step-wise fashion according to their significance. The variables which were selected as being related to head injury in motorcycle crashes were: Drinking, multiple vehicle crash, eye protection intact, impact speed, size of bike, driving experience, helmet worn, and helmet contact. Essentially, each of the aforementioned variables are in some way significantly related to the incidence of head injury in motorcycle crashes. Motorcycle helmet data, in this study, was collected according to whether the 1) helmet was worn at the time of the crash, 2) helmet was approved, 3) helmet made contact with another object at the time of crash, 4) helmet was broken, and 5) helmet was lost. The discriminant analysis of motorcycle accident selected two helmet related variables, helmet worn and helmet contact respectively. The variable of parmount interest as related to the scope of this analysis was helmet worn.

In looking at the significance of the helmet worn variable with respect to head injury severity, it was discovered that those individuals who wore helmets were less represented in terms of having sustained some form of head injuries. The value of helmet usage is dramatically demonstrated when looking at helmet use and severe head injuries. Of those sustaining severe head injuries, 73% of the total four year sample did not wear helmets as opposed to 27% who did wear helmets. A total of 76% of those individuals who sustained no head injuries in motorcycle crashes were wearing helmets as opposed to 67% who did not wear helmets. This analysis clearly demonstrates the relationship of helmet use and head injuries. There were fewer individuals who wore helmets and sustained injury than those who experienced head injuries and did not wear helmets. Additionally, there were also more individuals who sustained no injury and wore helmets as opposed to those not wearing helmets and incurring no head injury in the motorcycle crash.

Head Injury Severity Groups

Helmet Worn	None	Moderate	Severe
Yes	49%	47%	27%
No	51%	53%	73%
Total	100%	100%	100%

C. Fatality Profile

This section of the analysis deals with motorcycle fatalities. All data contained in this profile was extracted from officers' reports which were completed at the scene of each fatal motorcycle crash. The pertinent variables included in this analysis serve as descriptors of fatal motorcycle crashes. Such variables include type of fatal injury, accident location, age, manner of collisions, etc.

In Utah during 1975, there were a total of 21 motorcycle accidents in which the driver was killed, which represented 2% of all 1976 motorcycle crashes. During 1976, there were a total of 16 motorcycle accidents resulting in 17 motorcycle fatalities. Motorcycle fatal accidents in 1976 represented 2% of all 1976 motorcycle crashes. During 1977, Utah experienced a total of 23 motorcycle fatal accidents resulting in 24 fatalities, and accounting for 2% of all 1977 motorcycle accidents. In 1978, there were 22 fatal motorcycle crashes resulting in 23 deaths comprising 2% of all 1978 motorcycle crashes.

The location of the majority of fatal crashes in Utah, like total motorcycle crashes, have been in the urban areas in Salt Lake, Weber, Davis, and Utah counties. The only notable reduction occurred in Weber County, from four accidents in 1975 to one accident in 1976. In 1977, representation of fatal motorcycle accidents by county remained fairly consistent as related to 1975 and 1976. Salt Lake, Weber, and Utah Counties remained more highly represented than rural counties. These populous counties accounted for 67% of the statewide fatal crash occurrences, during 1975 through 1978. Some notable differences have been the reduction of Salt Lake County fatals and the increase in Utah County fatals during 1978.

Fatal Crashes

County	Total			
	1975	1976	1977	1978
Salt Lake	6	6	9	3
Weber	4	1	3	2
Utah	3	3	3	6
Millard	-	2	1	-
Emery	-	1	-	1
Davis	2	1	1	2
Summit	2	-	-	1
Garfield	1	1	-	-
Carbon	1	1	-	-
Tooele	1	1	1	-
San Juan	1	-	-	1
Cache	-	-	2	-
Washington	-	-	1	-
Box Elder	-	-	2	2
Uintah	-	-	-	1
Grand	-	-	-	1
Morgan	-	-	-	1
Sanpete	-	-	-	1
Total	21	16	23	22

During 1975 through 1978, the age span of motorcyclists who were killed in crashes ranged from 11 to 57 years of age. The motorcycle fatality group is clearly a young population. The percent of persons 30 years of age or younger killed on motorcycles was 71% in 1976, 67% in 1977 and 87% in 1978.

Age	Number				% of Total			
	1975	1976	1977	1978	1975	1976	1977	1978
Under 16	2	2	1	3	9%	12%	4%	13%
16 - 20	5	4	5	9	24%	24%	21%	39%
21 - 30	8	6	10	8	38%	35%	42%	35%
31 - 50	6	4	6	2	29%	24%	25%	9%
50 - +	-	1	2	1	-	5%	8%	4%
	21	17	24	23	100%	100%	100%	100%

In both 1975 and 1976, single vehicle type accidents were the most highly represented type of fatal crash. Such accidents involve only the motorcycle, which in most cases went off the road or collided with a fixed object (wall, pole, etc.). Accidents in 1977 and 1978 were more highly represented with respect to the angle type collision with another motor vehicle. In addition, there was a large reduction of single vehicle motorcycle fatalities during 1978 over the previous three years.

Manner of Collision	Fatalities			
	1975	1976	1977	1978
Rear End	1	1	-	3
Head-on	2	4	3	3
Angle	5	2	12	12
Single Vehicle	13	8	8	3
Sideswipe	-	1	-	1
Total	21	16	23	22

Travel speed, as related to motorcycle fatalities, demonstrates a positive relationship in terms of increased speed and number of fatalities. During all years it was found that, at higher speeds, the number of fatalities increased

significantly. Fewer of the motorcycle accidents which resulted in death occurred at travel speeds below 30 mph, while the majority occurred above 30 mph.

Travel Speed	Fatal Crashes			
	1975	1976	1977	1978
10-	1	-	-	1
10+	1	1	-	-
20+	-	1	-	-
25+	2	1	-	2
30+	3	2	3	4
35+	4	2	4	3
40+	2	2	1	1
45+	-	-	7	3
50+	4	3	5	1
55+	4	4	3	4
Unknown	-	-	-	-
Total	21	16	23	22

In addressing the helmet topic, it was found that of all years' motorcycle fatalities, 32 of the drivers were not wearing helmets, while 21 were. It was unknown whether 29 of the drivers were or were not wearing helmets. In carrying the analysis to determine the type of injury most closely associated with death, it was discovered that of the 32 individuals who had not worn helmets, 24 died as a result of head injuries while 8 died as a result of multiple injuries. Of the 21 drivers who were wearing helmets, 8 of those suffered head injuries, while the remaining 13 drivers with helmets suffered arm, torso, or multiple injuries.

Although the respective size of the total sample is not sufficient to draw reliable conclusions, it would seem that those who wore helmets were less likely to have died of head injuries which are also the most highly represented cause of death.

Fatal Head Injuries

Helmet Worn	1975	1976	1977	1978
Yes	3	2	1	2
No	5	6	8	5
Unknown	5	1	3	4
	13	9	12	11

D. Surveys

In order to fully investigate and adequately deomonstrate Utah's motorcycle situation, surveys were conducted during 1975 and 1976, respectively. Because of changes in Utah's motorcycle helmet legislation occurring in 1977, no surveys were conducted during that year. However, surveys were conducted during 1978 so as to determine the impact of legislative changes on public opinion and helmet usage.

1. Roadside Surveys

The major purpose of the roadside surveys was to measure the level of helmet use compliance among Utah motorcycle drivers. The method used to carry out this objective was through actual observation of motorcyclists on the State's streets and highways. The survey was conducted throughout the month of August in 1975, 1976 and 1978. Motorcyclists were surveyed at eighteen selected sites throughout the most heavily populated area of the State (Wasatch Front). All sites were selected so as to represent Interstate, Primary, and local roads, and were surveyed on selected days between the hours of twelve noon and 6:00 p.m. Additionaly, the sites were chosen to include roads posted both above and below 35 mph. The distribution of survey sites with respect to class of traffic way and speed limit is a follows:

Survey Site	Speed Limit	Class of Trafficway
Utah County		
Provo--University & 12th North	35	Local
Orem--State Street & 13th South	45	Primary
Provo--Canyon--U-89	50	Primary
Geneva--I-15	55	Interstate
Salt Lake County		
State Street & 33rd South	35	Local
Big Cottonwood Canyon	45	Primary
7th East & 13th South	35	Local
Redwood Road & 54th South	50	Local
Foothill Blvd. & 21st South	40	Primary-Local
4th South & State Street	30	Local
I-15 & 6th South	35-45	Interstate-Local
Davis County		
I-15 & US 84 near Clearfield	45-55	Interstate-Primary
US 89 at Fruit Heights	55	Primary
U 106--Bountiful	50	Primary
Weber County		
Washington Blvd. & 2nd Street	35-40	Local-Primary
Washington Blvd. & 35th Street	35	Local-Primary
Harrison Blvd & 30th Street	30	Local
Ogden Canyon	35	Primary

During the 1976 survey period, a total of 2,538 motorcyclists were observed. Of this total, 313 cyclists were observed on Interstate Highway; 1,196 observations were made on Primary roads; and the remaining 1,029 on local streets. An analysis of all motorcyclists observed in the survey revealed that in 1976, approximately 78% of the total sample wore helmets at all speeds regardless of street or highway. When categorized by class of trafficway, it was discovered that helmet compliance on freeways totaled approximately 99% in 1975 and 1976 primary, FAS, and FAS local represented 86% compliance in 1975 and 97% in 1976; and compliance on local roads reached 62% in 1975 and 53% in 1976. When the 35 mph speed limit was incorporated into the analysis and interstate and primary were combined, it was found that on these roads, which are also posted above 35 mph, there is a 91% compliance rate which represents a 3% drop from 1975. When looking only at local roads posted below 35 mph, it was observed that 58% of those surveyed wore helmets.

The 1978 survey showed dramatic drops in the number of individuals wearing helmets regardless of speed category. Overall helmet usage dropped from approximately 78-79% in 1975 and 1976 to 34% in 1978. Additionally, rates of helmet usage within different speed limits were significantly down in 1978 compared to 1975 and 1976. At speed limits above 35 mph, helmet compliance dropped from a two-year average of 92% to 42% in 1978. At speed limits below 35 mph, compliance dropped from an average of 61% to 24%.

Total Sample

				Category %			% of Total		
1975	1976	1978		1975	1976	1978	1975	1976	1978
3267	2538	3475	Total Sampled	100%	100%	100%	100%	100%	100%
2584	1973	1170	Wearing Helmets	79%	78%	34%	79%	78%	34%
472	414	2179	Not Wearing Helmets	15%	16%	63%	15%	16%	63%
211	151	126	Helmet Observed on Bike	6%	6%	3%	6%	6%	8%

Compliance by Speed Limit

Above 35 mph

				Category %			% of Total		
1975	1976	1978		1975	1976	1978	1975	1976	1978
1594	1496	2068	Total Sampled	100%	100%	100%	48%	59%	60%
1463	1368	860	Wearing Helmets	94%	91%	42%	45%	54%	25%
86	98	1162	Not Wearing Helmets	5%	7%	56%	3%	4%	33%
25	30	46	Observed on Bike	1%	2%	2%	-	1%	1%

Compliance by Speed Limit

Below 35 mph

				Category %			% of Total		
1975	1976	1978		1975	1976	1978	1975	1976	1978
1693	1042	1407	Total Sampled	100%	100%	100%	52%	41%	40%
1102	605	333	Wearing Helmets	65%	58%	24%	34%	24%	10%
405	316	1028	Not Wearing Helmets	24%	30%	73%	12%	12%	30%
186	121	46	Observed on Bike	11%	12%	3%	6%	5%	1%

The results of the roadside surveys which were conducted in 1975 and 1976 demonstrated very promising results in terms of the motorcyclist's compliance with Utah's helmet law. In 1976, mandatory compliance, or helmet use on streets and highways above 35 mph where helmet use is enforced, remained high (91%). Additionally, the 58% rate of voluntary compliance, although down from 1975, is very significant when considering that helmet use was not required by law and, therefore, not enforced at those speeds. The overall compliance rate of 78% was also very significant considering the fact of partial helmet legislation.

The 1978 sample, however, demonstrated a significant decrease in the use of motorcycle helmets regardless of speed. The last of the surveys was conducted approximately one year following the substantial lessening of protective equipment standards by the Utah State Legislature. The frequency of helmet use decreased by more than half among Utah motorcyclists from 78% compliance prior to 1977, to 34% in 1978. Such decreases in helmet use would seem to be attributable to the fact that the helmet issue had lost a substantial degree of public emphasis regarding adherence to the mandatory use of helmets. As a result, several states, including Utah, initiated efforts involving the partial, and in some cases, total repeal of helmet laws. The publicity surrounding these situations is believed to have created somewhat of a negative attitude on the part of motorcyclists and their willingness to wear helmets.

2. Opinion Surveys

The analysis of the motorcycle safety environment in Utah was extended still further through opinion surveys which were administered during 1975, 1976, and 1978.

Each survey was carried out through the use of questionnaires which were distributed randomly at driver license examining stations in selected counties of the State. A total of approximately 1,100 individuals were sampled throughout the Wasatch Front region of Utah. This particular four-county area represents approximately 85% of the State's population. The survey was stratified so as to include approximately 550 motorcyclists and 550 individuals representing the general driving public. This was done in order to distinguish between the views of the above two groups.

Sample Distribution 1975, 1976, and 1978

County	% of Sample	Motorcyclists	Driving Public
Davis	15%	79	79
Salt Lake	51%	281	281
Utah	17%	95	95
Weber	17%	95	95
Total	100%	550	550

The following analysis will be sub-categorized into three major groups. These groups will consist of Survey Profile, Helmet Law Opinions, and Highway Safety Priorities.

a. Survey Profile

A profile of the individuals surveyed showed that approximately 70% of the total sample were males and 30% females in 1975 and 1976, and 77% males and 23% females in 1978. When considering sex by class (motorcyclist - non-motorcyclist), the surveys showed that the ratios of male to female motorcyclists were 86% to 14% in 1975, 84% to 16% in 1976, and 87% to 13% in 1978. The distribution of sex among the general driving public demonstrated a 53% to 47% ratio in 1975, 58% to 42% in 1976, and 70% to 30% in 1978. While there is very little, if any, significant difference in the above ratios

between 1975 and 1976, there were significantly more males represented in the 1978 sample.

Sex

	Male			Female		
	1975	1976	1978	1975	1976	1978
Total Sample	70%	70%	77%	30%	30%	23%
Motorcyclist	86%	84%	87%	14%	16%	13%
Driving Public	53%	58%	70%	47%	42%	30%

In attempting to determine the respective ages of Utah drivers, the sample results demonstrated the following:

Age Profile

Age	Motorcyclist %			Driving Public		
	1975	1976	1978	1975	1976	1978
16 - 20	26	21	38	16	16	28
21 - 25	23	20	25	13	19	21
26 - 30	16	18	12	14	11	14
31 - 35	9	10	8	14	12	11
36 - 40	9	9	7	9	10	7
41 - 45	6	7	4	7	6	7
45 - 50	5	4	3	7	8	5
50+	6	11	3	20	18	7

Individuals were also surveyed to determine the number of motorcycle miles driven weekly. The 1975 results showed that 51% of the motorcyclists questioned drive less than 100 miles per week, 55% in 1975 and 54% in 1978. This analysis shows very little change among motorcyclists questioned in the three surveys. When the same question was asked of individuals representing the general driving public, it was found that motorcycle driving has steadily increased over the three year period. The most pronounced increase occurred

among those drivers who drive motorcycles between one and 99 miles per week - 9% in 1975, 15% in 1976, and 30% in 1978.

Weekly Motorcycle Driving Miles

Miles Per Week	Motorcyclists			Driving Public		
	1975	1976	1978	1975	1976	1978
1 - 99	55%	51%	44%	9%	15%	30%
100 - 199	13%	12%	14%	3%	3%	8%
200 - 299	5%	5%	4%	.5%	-	3%
300+	3%	3%	2%	-	1%	1%
None (or no response)	24%	29%	26%	87.5%	81%	58%

b. Helmet Usage

Other propositions which were extracted from the surveys dealt with helmet use compliance rates among motorcyclists. Two questions were included in the survey in order to draw an accurate conclusion. One of the questions dealt with helmet use on city streets and highways, and the other with roads posted above and below 35 mph.

Responses to the city-highway helmet use question were significantly lower in 1976 compared to 1975 regarding the use of headgear by motorcyclists. Helmet use figures on the 1978 respondents were surprisingly higher than in 1976. This would tend to demonstrate an increase in helmet usage one year after the helmet law had been relaxed over 1976, the year before the law had been changed.

Highway - City Street Helmet Use

	Highway			City Street		
	1975	1976	1978	1975	1976	1978
Yes	72%	59%	63%	64%	54%	60%
No	28%	41%	37%	36%	46%	40%

In answer to the question as to how often helmets are worn at speeds above and below 35 mph, a total of 53% of the 1978 sample indicated the use of helmets at speeds below 35 mph, while 61% of the cyclists indicated that helmets were used at speeds above 35 mph. As indicated by the 1975 survey, levels of helmet use are somewhat higher than the 1976 survey.

Helmet Use above and below 35 MPH

	Above 35 MPH			Below 35 MPH		
	1975	1976	1978	1975	1976	1978
Yes	72%	60%	61%	57%	50%	53%
No	28%	40%	39%	43%	50%	47%

The foregoing analysis has shown that helmet use has increased slightly over 1976, but remains below 1975 levels. The above remains contrary to expected decreases in helmet compliance resulting from a lessening of the legal requirements related to helmet use. Although the opinion survey results have shown an increase in helmet compliance, these results are in sharp contrast to the roadside surveys of helmet use. The latter showed marked decreases in helmet usage.

c. Highway Safety Priorities

The following analysis has been included as an attempt to determine which of several highway safety priorities are foremost in the minds of motorcyclists and the general driving public. The opinion survey contained a list of four highway safety concerns which the respondents were asked to list according to importance. The concerns which were included in the survey were drinking drivers, road maintenance, vehicle equipment, and motorcycle safety. Each topic was given five degrees of importance, with the fifth degree as being most important and the first degree as least important.

When looking at the drinking driver as an important highway safety priority, it was discovered that 93% of the motorcyclists considered it important while 5% thought it to be unimportant. The remaining 2% saw the drinking driver as an average concern. Responses extracted from the general driving public were similar with 93% of the respondents seeing drinking as being important, 6% unimportant, and 1% viewed drinking as an average concern.

When road maintenance was observed, it was found to be considered important by 85% of the motorcyclists, unimportant by 5%, and average by 10%. The same concern when presented to the general driving public rendered basically similar results.

Considering vehicle equipment, 75% of the cyclists sampled viewed this variable as being important. The remaining 8% considered vehicle equipment to be unimportant and 17% as an average priority. Again, the general driving public sample responded in a similar fashion.

The issue of foremost concern in this study was how the motorcyclists and driving public differed on the motorcycle's priority position in highway safety. Of the motorcyclists surveyed, 80% considered this avriable to be very important. A total of 8% of those individuals viewed motorcycles as unimportant and the remaining 12% of the sample responded average. On the other hand, the respondents representing the general driving public answered quite differently. Approximately 69% of those individuals considered the motorcycle concern important. The remaining 16% believed the concern to be unimportant, and 15% considered it average.

Highway Safety Priorities

1978

	Important		Unimportant		Average	
	Motor-cyclist	Driving Public	Motor-cyclist	Driving Public	Motor-cyclist	Driving Public
Drinking Driver	93%	93%	5%	6%	2%	1%
Roadway Maint.	85%	87%	5%	5%	10%	8%
Vehicle Equip.	25%	77%	8%	9%	17%	14%
Motorcycles	80%	69%	8%	10%	12%	15%

When looking at the above lists of selected concerns, it has been shown that drinking driver and roadway maintenance are the most important concerns among both the motorcycle and general driving population. With this similarity in mind, it is indeed significant that the motorcycle priority is not highest in the minds of motorcyclists. It is clear, however, that this concern stands out much more among cyclists as opposed to individuals representing the driving public.

IV. CONCLUSIONS

1. Comparisons concerning motorcycle injuries and fatalities between 1969 and 1978 have demonstrated that the motorcycle is not over-represented in terms of Utah's accident picture. There was a 121% increase in injury accidents in 1969 over 1978. However, the number of 1977 motorcycle registrations has increased 153% during the past nine years. The number of 1978 motorcycle fatalities per registration remains below the nine year average. Fatalities as a percentage of motorcycle accidents remained at 2% in 1975, 1976, 1977 and 1978.
2. Driving experience plays a significant role in motorcycle crashes. From 1975 to 1978, approximately one half of the motorcycle accidents were represented by the driver having only two years of motorcycle driving experience.
3. The highest proportion of motorcycle crashes, injuries and fatalities occur when the motorcycle driver is young. During the four year sample, 72% of the drivers were 30 years old and younger.
4. In 1975, the most populated region of the State (Wasatch Front--85% population) was represented by the greatest proportion of motorcycle crashes. While the above area was most highly represented in each years' accident picture, the relative number of crashes have decreased in the Wasatch Front since 1975. The samples demonstrated a slight increase in the rural, or more sparsely populated counties of the State. In addition, the majority of accidents continue to occur in urban as opposed to rural areas.
5. The majority of motorcycle drivers in the four year sample had significantly more previous accidents and traffic violation convictions than

the general driving population. Although, this trend has steadily declined over the four year sample.

6. As observed in the accident sample, the number of individuals wearing helmets and eye protection at the time of the accident decreased dramatically in 1977 and 1978. In terms of helmet use, a decline was noted both in the accident sample as well as roadside survey results; from an overall compliance level of approximately 78% in 1975 to a present 34% level.
7. Larger motorcycles are more highly represented in motorcycle crashes each year. In 1978, the number of larger motorcycles (400cc+) involved in accidents, increased over 1975, 1976 and 1977.
8. There is a trend away from seasonal clusters of motorcycle accidents. In 1975, 99% of the accident sample was drawn during this period. In 1978, 72% of the accidents occurred from May to September, and the remaining 28% from October to April.
9. The most prominent accident circumstances associated with motorcycle crashes, injuries, and fatalities are speeding, reckless driving, failure to yield, and drinking. The number of motorcycle crashes involving drinking had decreased steadily from 1975 to 1978.
10. Most motorcycle accidents are multiple vehicle as opposed to single vehicle. The frequency of angle collisions has increased over the years and is by far the most prominent type of accident.
11. The majority of all bodily injuries in motorcycle crashes occur to the legs; arm and torso injuries follow, and the least represented injuries are head injuries. The discriminant analysis of head injury severity rendered conclusive evidence that safety helmets are significant with

respect to head injuries. It was discovered that those individuals who wore helmets were less represented in terms of having sustained some form of head injury.

12. The majority of drivers killed who were known not to be wearing helmets suffered death as a result of head injuries. Conversely, the majority of drivers killed who were known to be wearing helmets died as a result of multiple or torso injuries.

V. EXECUTIVE SUMMARY

The major issue with which Utah has been involved in the area of motorcycle safety concerns the value of protective headgear in motorcycle crashes. In this context, the value of the safety helmet is specifically equated with its role regarding head injuries. The point to emphasize is that helmet use is solely related to the protection of the cyclists's head and is not a preventive device in curtailing motorcycle crashes.

In this analysis, the helmet has been investigated solely in terms of a protective device which may affect the degree of head injury sustained in a motorcycle crash. Through a series of analytical procedures, statistically verifiable conclusions have been reached which equate helmet usage with the severity of head injuries. The statistical methods of analysis used in this study are meant to extract those variables which are extremely significant in their relationship to head injury. The fact that the helmet variable was selected indicates that helmets are crucial in reducing or preventing head injury severity. Those who were involved in crashes and wore helmets sustained less head injury than those not wearing helmets. Therefore, many of the issues surrounding the value of helmet use and injury severity merit rather serious examination.

Looking at the fatality analysis as an indication of the value of safety helmets, we find that a definite statement is difficult to develop. In the analysis of 1975, 1976, 1977 and 1978, motorcycle fatalities, it was found that of the motorcycle drivers who were known not to be wearing helmets a majority died as a result of head injuries. On the other hand, of the drivers who were wearing helmets, fewer died as a result of head injuries.

Based on first impression, the above could indicate that helmets do serve some value in preventing serious head injury which may in turn result in death. The question which remains, however, deals with whether the helmet would prevent death in a serious crash. In short, if those without helmets would have worn helmets, would a fatality have been averted? This thought is compounded by the fact that many fatalities occur at higher travel speeds. Serious questions remain open pertaining to the helmet's value in preventing death. particularly in high speed crashes.

Amendments which were made with respect to Utah's helmet law during 1977 have also had an effect on the results of this analysis. The rates of helmet use dropped from a level of approximately 78% in 1975 and 1976 to approximately 34% in 1977 and 1978. The effects of lowered use of helmets may have impacted an increase in terms of individuals sustaining head injuries in 1977 crashes. The number of individuals who suffered severe head injuries in 1977 and 1978 accidents rose substantially over 1975 and 1976.

The most significant factor related to the causes of motorcycle crashes is speed. Those factors which most often contributed to motorcycle mishaps were speeding, reckless driving and drinking. In accidents where the motorcycle driver was directly at fault, it was found that the accidents were caused by speeding, followed by reckless driving and drinking. In the 1977 sample, however,

no fatalities occurred as a result of drinking, and the incidence of drinking dropped dramatically as a contributing factor in accidents.

Factors which deserve attention due to their role in influencing motorcycle crashes include motorcycle size and motorcycle driving experience. It was discovered that the respective size of the motorcycle has some relationship to the frequency of accidents. For example, motorcycles under 99 cubic centimeters were represented in relatively few accidents. As motorcycle size increased, as measured by cubic centimeters, the accident involvement of larger motorcycles also increased.

The analysis of 1975, 1976, 1977 and 1978 motorcycle crashes also demonstrated that motorcycle driving experience is very much related to motorcycle accidents. A large number of all motorcycle crashes were represented by a motorcycle driver with less than five years of motorcycle driving experience. Driving experience was also analyzed in terms of the driver's experience on the motorcycle involved in the crash. During each year, the resulting proportions were astonishingly high. It was found that nearly all of the drivers had driven their motorcycle less than five years. The most significant factor was that nearly three quarters of the motorcycle accidents were represented by drivers with less than one year of experience on the cycle which was driven at the time of the accident.